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Effect of The Interaction Between The Mineral and Bio-Fertilizer on The Productivity of Cantaloupe (*Cucumis melo* L.) under The Newly Reclaimed Soils Conditions

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TWO field experiments were conducted during 2000 and 2001 seasons in El-Bosaily Protected Cultivation Unit, El-Behaira Governorate to study the response of cantaloupe plants to mineral, bio-fertilizer as well as their interaction on the productivity of cantaloup plants. Each experiment included six treatments representing the interaction of two mineral fertilizer levels (low: 80, 32, 48 kg/fed and high level : 100, 32, 72 kg/fed. of N, P_2O_5 and K_2O, respectively) and three bio-fertilizer levels (0, 2, 3 kg/fed.of Biogein).

Data indicated that the vegetative growth expressed as plant height, number of leaves and dry matter of whole plant was improved with the high mineral fertilizer level and with the addition of bio-fertilizer than the control plants. The most favourable interaction treatment was the higher level of mineral fertilizer combined with 3 kg of bio-fertilizer. Also, leaves mineral contents of N, P and K were highest with the interaction between mineral fertilizer (high level) and bio-fertilizer (3 kg/fed). Early and total fruit yield were highest in plants treated with the high mineral fertilizer level and 3 kg./fed. of bio-fertilizer which, in turn, showed the most favourable fruit quality characters (average fruit weight, total soluble sugars and total soluble solids).

Cantaloupe (*Cucumis melo* L.) is a popular consuming crop in Egypt. It can do well in moderately sandy soil. In Egypt, the attention nowadays is toward expending the area of production through planting the newly reclaimed sandy soils. So, studying the factors affecting the productivity of sandy soils are useful to get high return from it.

One of the most important factors affecting the productivity of the crops is use of fertilizers. Applications of N and K to muskmelon were reported to have a considerable increase in plant growth (Dufault, 1986, El-Beheidi *et al.* 1988a and El-Desuki *et al.*, 2000). The uptake of N and P by melon plants was increased with the increase of N applications but K uptake was reduced, as reported by Elamin & Wilcox (1986 a and b) and El-Beheidi *et al.* (1988a).

The positive effect of N fertilizer on yield and fruit quality of melons was reported by Roorda *et al.* (1982), Srinivas & Prabhaker (1984), Damarany & Farag (1994) and El-Desuki *et al.* (2000). Concerning the effect of potassium, Kim & Ito (1983), El-Bheidi *et al.* (1988b) and El-Desuki *et al.* (2000) reported that the application of K had an increased yield and improved fruit quality *i.e.* fruit weight, sugar content and T.S.S.

Bio-fertilizers have a significant effect may be due to the effect of different strain groups such of nitrogen fixers, nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable N, P, K, Fe, Zn and Mn (El-Kramany *et al.* 2000). Bio-fertilizer application improves plant growth, fruit yield and chemical composition, as compared with the untreated plants (Abdalla *et al.*, 2001 on pepper plants and Abd El-Mouty *et al.*, 2001 on potato plants). Application of NPK with bio-fertilizer resulted in the best growth and total yield of garlic plants (Ali *et al.*, 2001).

The present study was initiated to elucidate the beneficial effects of using two levels of mineral fertilizer (N and K) and three levels of Bio-fertilizer on the growth, yield and fruit quality of cantaloup plants.

Material and Methods

Two successive experiments were conducted in El-Bosaily Protected Cultivation Unit, El-Behaira Governorate in 2000 and 2001 seasons to study the influence of two mineral fertilizer levels combined with three bio-fertilizer levels on the productivity of cantaloupe plants under the newly reclaimed soil conditions.

The experimental soil was sandy in texture with pH 7.92 and E.C. 3.0 mmhos. Soil chemical analysis showed that it contains 11.6 meq/l of Mg, 12.77 meq/l of Na, 11.8 meq/l of Ca, 2.95 meq/l of HCO_3 and 13.46 meq/l of Cl.

Each experiment included six treatments and four replicates. The experimental design was split plot where the mineral fertilizer treatments were assigned in the main plots and the bio-fertilizer treatments were destributed in the sub plots.

The mineral fertilizer treatments were as follows :
1. Low level : 80, 32, 48 kg/fed of N, P_2O_5 and K_2O, respectively.
2. High level : 100, 32, 72 kg/fed of N, P_2O_5 and K_2O, respectively.

The bio-fertilizer treatments were: without, 2 and 3 kg/fed of Biogeing.

Uniform and healthy seedlings of cantaloupe (*Cucumis melo* L.) cv. Imperial 45 of 21 days age were transplanted on 21^{st}, 25^{th} February of 2000 and 2001 seasons, respectively. Each experimental plot consisted of five rows each of 5.0 m length and 1.5 meter width. Distance between plants was 50 cm.

Six weeks after transplanting, a random sample of three plants was taken from each plot for the vegetative growth measurements, *i.e.* plant height, number of leaves per plant and dry weight per plant. Mineral contents of nitrogen, phosphorus and potassium were determined as a percentage of the dry weight according to Black (1983), Watanab & Olsen (1965) and Jackson (1965), respectively.

At harvest (75 days after transplanting), fruits were collected and average fruit weight, early and total yield were recorded. A random sample of fruits from each experimental plot was taken for T.S.S. and total soluble sugars measurements according to A.O.A.C. (1975).

Obtained data were statistically analyzed according to Mead *et al.* (1993) using the L.S.D. method at 5 % level of significance.

Results and Disucssion

Vegetative growth

Effect of mineral fertilizer

Data shown in Table 1 indicated that cantaloupe plants receiving high mineral fertilizer level (100, 32, 72 kg/fed of N, P_2O_5 and K_2O, respectively) showed higher values of plant growth characters as compared to those receiving low mineral fertilizer level (80, 32, 48 kg/fed of N, P_2O_5 and K_2O, respectively). Such effect was observed with respect to plant height, number of leaves pre plant and dry matter content, in both 2000 and 2001 seasons. The increases in the mentioned growth characters may be attributed to high mineral fertilizer level which was statistically significant in both seasons.

TABLE 1. Effect of mineral and bio-fertilizers on the growth and chemical composition characters of cantaloupe plants in 2000 and 2001 seasons.

Characters / Treatments		Plant height (cm)		No. of leaves/plant		Dry weight g/plant		Leaves mineral contents (% of dry matter)					
								N		P		K	
Mineral fertilizer levels	Bio-fertilizer (kg/fed.)	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
T_1	without	83.4	79.8	69.3	67.7	25.3	22.7	2.73	2.63	0.57	0.63	1.86	1.75
	2	89.6	86.0	73.0	68.9	31.6	26.5	2.89	2.69	0.65	0.72	1.89	1.82
	3	95.3	94.7	80.6	74.5	35.7	29.4	3.13	2.94	0.84	0.85	2.08	1.95
Mean		89.4	86.8	74.3	70.4	30.9	26.2	2.92	2.75	0.69	0.73	1.94	1.84
T_2	without	96.7	85.9	77.6	73.4	29.8	28.6	2.93	2.71	0.63	0.69	2.56	2.25
	2	103.4	94.3	84.6	76.2	37.6	33.0	3.52	3.17	0.75	0.86	2.61	2.34
	3	104.0	99.4	93.6	82.1	41.2	38.7	3.94	3.62	0.89	0.93	2.68	2.41
Mean		101.4	93.2	85.3	77.2	36.2	33.4	3.46	3.17	0.76	0.82	2.62	2.33
Average of Bio-fertilizer	without	90.1	82.9	73.5	70.6	27.6	25.7	2.83	2.67	0.60	0.66	2.21	2.00
	2	96.5	90.2	78.8	72.6	34.6	29.8	3.20	2.93	0.70	0.79	2.25	2.08
	3	99.7	97.1	87.1	78.3	38.5	34.1	3.54	3.28	0.87	0.89	2.38	2.18
L.S.D. 5 %													
Mineral fertilizer		8.3	7.2	9.3	6.1	4.1	4.3	0.36	0.31	N.S	N.S	0.46	0.43
Bio-fertilizer		N.S	N.S	10.2	7.3	6.0	5.8	0.42	0.39	N.S	N.S	N.S	N.S
Interaction		13.6	12.1	14.2	11.7	5.7	5.4	0.81	0.73	0.26	0.22	0.62	0.57

T_1 = Low mineral fertilizer level (80, 32, 48 of N, P_2O_5 and K_2O kg/fed)

T_2 = High mineral fertilizer level (100, 32, 72 of N, P_2O_5 and K_2O kg/fed).

The increase in plant growth due to the increase in mineral fertilizer was previously reported by El-Beheidi *et al.* (1988a) on sweetmelon, Kunwar & Pandey (1992), Selvaraj *et al.* (1993), Wange (1997) on garlic, El-Desuki *et al.* (2000) on cantaloupe, Adam *et al.* (2001), Ali *et al.* (2001) and Adam (2002) on *Vicia faba* who mentioned that the medium or high rate of NPK application gave the best growth characters of the plant. They added that the increase in the vegetative growth due to higher NPK levels might be referred to its favourable role in increasing the availability of nutrients to plant absorption and higher photosynthetic activity. Such role might be due to the role of nitrogen in the synthesis of plant proteins, pigments and enzymes. In addition, the role of potassium on promoting enzymes activity and enhancing assimilates translocation and protein synthesis (El-Beheidi 1988a). Obtained results agreed with Abdalla *et al.* (2001).

Effect of bio-fertilizer

Bio-fertilizer treatments significantly increased plant growth characters, (number of leaves and dry matter content per plant) as shown in Table 1. Although this effect was obvious in both seasons, the increase in plant height due to bio-fertilizer was insignificant. Data also indicated that the high level of bio-fertilizer, *i.e.* 3 kg/fed overcame the low level, *i.e.* 2 kg/fed, in both seasons.

Application of bio-fertilizer encouraged plant growth characters of many crops, as recorded by Mansour (1998), El-Kramany *et al.* (2000), Rizk & Shafeek (2000) on *Vicia faba*, Abdalla *et al.* (2001), Adam *et al.* (2001) on pepper, Abdel-Mouty *et al.* (2001) on potato and Adam (2002) on *Vicia faba* .

Effect of the interaction

Data in Table 1 showed that the most favourable interaction treatment for plant growth was the high level of mineral fertilizer with the highest bio-fertilizer dose (3 kg/fed). However, the lowest was the low level of mineral fertilizer with zero bio-fertilizer. This effect was true in both seasons for plant height, number of leaves and dry matter content.

Obtained results agreed with El-Desuki *et al.* (2000) who mentioned that medium or high rate of NPK application gave the best growth of cantaloupe plants, Ali *et al.* (2001) who reported that application of NPK with bio-fertilizer resulted in the best plant growth and dry weight content and El-Kramany *et al.* (2000), Adam (2002) who reported that the interaction between bio- and chemical fertilizer significantly improved plant growth.

Mineral content

Effect of mineral fertilizer

The presented data in Table 1 showed the effect of different mineral fertilizer levels (high and low) on the minerals (N, P and K) contents of cantaloupe plants. Data indicated that the higher fertilizer level resulted in a higher nutrients percentage in plant tissues. Although such increment was observed in both seasons, it was only significant for nitrogen and potassium contents.

The obtained results agreed with those of El-Beheidi *et al.*(1988a), El-Desuki *et al.* (2000), El-Kramany *et al.* (2000), Adam *et al.* (2001) and Adam (2002).

Effect of bio-fertilizer

Data in Table 1 indicated that the leaves minerals contents of N, P and K were increased due to bio-fertilizer addition, as compared to the control (without bio-fertilizer). Such increment was parallel to the increase of bio-fertilizer dose, in both seasons. However, such increment was only significant with respect to nitrogen content.

The obtained results were in agreement with Ali *et al.* (2001), Abdalla *et al.* (2001) and Adam (2002) who indicated that plants mineral content was improved due to bio-fertilizer treatments. Soil microorganisms known as phosphate solubilizing bacteria play a fundamental role in correcting the solubility problem in many soils, by releasing the fixed form to soluble form to be ready for plant nutrition (El-Sheekh, 1997).

Effect of the interaction

Data in Table 1 show that the interaction between mineral and bio-fertilizer

improved plant mineral content which produced its highest values with the high level of mineral fertilizer combined with 3 kg/fed of bio-fertilizer treatment, with respect to N,P and K contents. Whereas, the lowest contents were recorded with cantaloupe plants receiving the low mineral fertilizer level and receiving zero bio-fertilizer. Such increment was significantly observed in the two experimental seasons.

The obtained results agreed with Ali *et al.* (2001) and Adam (2002) who concluded that the interaction between mineral and bio-fertilizer improved the nutritional value of treated plants, as compared to the control.

Fruit yield

Effect of mineral fertilizer

Data in Table 2 indicate that early and total fruit yield of cantaloupe were significantly increased due to the increase of mineral fertilizer level, in both 2000 and 2001 seasons. The positive influence of high mineral fertilizer was previously demonstrated by many investigators, *i.e.* El-Desuki *et al.* (2000) who mentioned that medium and high fertilizer levels produced the highest fruit yield, El-Beheidi *et al.* (1988b), Adam (2002) who concluded that fruit yield was less affected by bio-fertilizer treatments than mineral fertilizer. Adam *et al.* (2001) mentioned that high mineral fertilizer level recorded the highest fruit yield .

Effect of bio-fertilizer

Presented data in Table 2 show that early and total yield recorded higher values with bio-fertilizer treatments, as compared to the control (without bio-fertilizer). Data also indicated that such increment was shown in both 2000 and 2001 seasons, however,it was only significant with total fruit yield parameter. The highest early and total fruit yield values were recorded with cantaloupe plants receiving 3 kg/fed of bio-fertilizer, in both seasons.

The stimulatory influence of bio-fertilizer on fruit yield was reported by some investigators which supports our results, *i.e.* (El-Krmany *et al.* 2000, Abdalla *et al.* 2001, Ali *et al.* 2001 and Adam 2002).

TABLE 2. Effect of mineral and bio-fertilizers on fruit yield and quality characters of cantaloupe in 2000 and 2001 seasons.

Characters		Marketable yield (ton/fed.)				Fruit quqlity					
Treatments		Early		Total		Fruit weight/g		Total sugar %		T.S.S.	
Mineral fertilizer levels	Bio-fertilizer (kg/fed.)	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
T_1	without	0.914	0.936	8.64	8.34	678	657	5.22	5.34	9.51	9.63
	2	0.980	0.987	9.32	9.06	718	709	5.61	5.72	9.72	9.78
	3	1.135	1.169	9.73	9.82	745	723	5.86	5.89	9.87	9.91
Mean		1.010	1.031	9.23	9.07	714	696	5.56	5.68	9.70	9.77
T_2	without	1.151	1.236	9.82	9.68	812	798	6.13	6.21	10.43	10.76
	2	1.362	1.561	10.13	9.95	822	819	6.72	6.81	11.22	11.31
	3	1.081	1.127	10.46	10.31	837	836	6.35	6.29	11.07	10.95
Mean		1.198	1.308	10.14	9.98	824	817	6.40	6.44	10.91	11.01
Average of Bio-fertilizer	without	1.033	1.086	9.23	9.06	745	728	5.68	5.78	9.97	10.20
	2	1.171	1.274	9.73	9.51	770	764	6.17	6.27	10.47	10.55
	3	1.108	1.148	10.10	10.07	791	780	6.11	6.09	10.47	10.43
L.S.D. 5 % :											
Mineral fertilizer		0.167	0.182	0.83	0.79	93	98	0.56	0.61	0.65	0.71
Bio-fertilizer		N.S	N.S	0.78	0.86	N.S	N.S	0.47	0.34	0.31	0.29
Interaction		0.236	0.319	1.13	1.25	87	95	1.08	1.11	0.93	0.87

T_1 = Low mineral fertilizer level (80, 32, 48 of N, P_2O_5 and K_2O kg/fed) .

T_2 = High mineral fertilizer level (100, 32, 72 of N, P_2O_5 and K_2O kg/fed).

Effect of the interaction

Data in Table 2 show the interaction effect of mineral and bio-fertilizers on early and total fruit yield of cantaloupe during 2000 and 2001 seasons. It could be concluded that the higher mineral fertilizer level combined with 3 kg/fed bio-fertilizer treatment significantly maximized both early and total fruit yield, as compared to the lower mineral fertilizer level and zero bio-fertilizer. Such effect was observed in the two experimental seasons; whereas the highest yield was recorded with the higher mineral fertilizer level combined with 3 kg/fed of bio-fertilizer . The lowest fruit yield was detected with the lower mineral fertilizer combined with zero bio-fertilizer.

The stimulatory effect of the interaction between mineral and bio-fertilizer was demonstrated in the previous researches which supported our results. Whereas, Ali *et al.* (2001) concluded that the heaviest total fruit yield was recorded with applying NPK and bio-fertilizer. Adam (2002) concluded that the interaction between the bio and mineral fertilizer resulted in a significant increase in fruit yield. It could be concluded that the stimulatory influence of both mineral and bio-fertilizer on the vegetative growth of the plants reflected to increase the final product, *i.e.* fruit yeild.

Fruit quality

A. Effect of mineral fertilizer

The response of fruit quality characters, *i.e.* average fruit weight, percentages of total soluble sugars and total soluble solids to mineral and bio-fertilizer treatments as well as their interaction is shown in Table 2. Average fruit weight was significantly increased due to the high level of mineral fertilizer, in both seasons. Percentages of total soluble sugars and T.S.S. were significantly higher in the fruits receiving the higher mineral fertilizer level, as compared to the low level, in both 2000 and 2001 seasons.

The promotry effect of mineral fertilizers on fruit quality characters was indicated by El-Beheidi *et al.* (1988b), El-Desuki *et al.* (2000), Ali *et al.* (2001), Adam *et al.* (2001) and Adam (2002) . Such promotry effect might be attributed to the stimulatory effect of mineral fertilizer on the vegetative growth parameters which enables more absorption of minerals by plant roots, which in turn, reflect a good fruit yield with the best fruit quality.

Effect of bio-fertilizer

Data in Table 2 indicated that fruit quality characters were improved due to bio-fertilizer treatments, as compared to the control (zero bio-fertilizer) and were highest with 3 kg/fed of bio-fertilizer treatment, in both seasons. However, such improvement was only significant with total soluble sugars and T.S.S. percentages.

The positive effect of bio-fertilizer on fruit quality as an expected response due to the effect on vegetative growth of plants and its fruit yield was detected by El-Kramany *et al.* (2000), Abdalla *et al.* (2001), Ali *et al.* (2001) and Adam (2002) who supported the obtained results in the present study.

Effect of the interaction

The presented data in Table 2 showed the effect of the interaction between mineral and bio-fertilizer on fruit quality characters of cantaloupe. The highest average fruit weight values were recorded with the higher mineral fertilizer rate combined with 3 kg/fed of bio-fertilizer. Whereas the lowest were recorded with the lower mineral fertilizer rate combined with (zero bio-fertilizer). However, the higher values of total soluble sugars and T.S.S. percentages were recorded with the higher mineral fertilizer level combined with 2 kg/fed of bio-fertilizer, without significant differences with high mineral fertilizer combined with 3 kg of bio-fertilizer treatment, in both seasons.

The percentages of total soluble sugars and T.S.S. showed the lowest values with cantaloupe plants receiving the low mineral fertilizer level combined with (zero bio-fertilizer), in 2000 and 2001 seasons. The obtained results were in agreement with those reported by Ali *et al.* (2001) and Adam (2002).

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تأثير التفاعل بين السماد المعدنى والحيوى على انتاجيـــة الكنتالـــوب تحت ظـــروف الأراضى المستصلحة حديثا

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أجريت تجربتين حقليتين فى موسمى ٢٠٠٠ ، ٢٠٠١ بوحدة الزراعة المحمية بالبوصيلى - محافظة البحيرة- وذلك لدراسة تاثير مستويين من التسميد المعدنى (٨٠ : ٣٢ : ٤٨ و١٠٠ : ٣٢ : ٧٢ كجم/فدان من النتروجين ، خامس اكسيد الفوسفور واكسيد البوتاسيوم على التوالى) وكذلك ثلاثة مستويات من التسميد الحيوى (بدون ، ٢ كجم/فدان ، ٣ كجم/فدان بيوجين) .

اشتملت كل تجربة على ستة معاملات وزعت فى نظام القطع المنشقة حيث وزعت معاملات السماد المعدنى فى القطع الرئيسية بينما وزعت معاملات السماد الحيوى فى القطع الفرعية .

أثبتت النتائج المتحصل عليها ان :

١- اضافة السماد المعدنى بالتركيز الاعلى أدى الى زيادة قياسات النموالخضرى (ارتفاع النبات - عدد الاوراق - المادة الجافة).

٢- اضافة السماد الحيوى أدى الى زيادة قياسات النموالخضرى ومحتوى الاوراق من العناصر (النتروجين والفوسفور والبوتاسيوم) وكانت افضل مايمكن مع المعاملة ٣ كجم/فدان بيوجين

٣- افضل المعاملات للنمو الخضرى ومحتوى الاوراق من عناصر النتروجين والفوسفور والبوتاسيوم كانت اضافة المعدل العالى من السماد المعدنى مع ٣ كجم/فدان بيوجين .

٤- كان لاضافة السماد المعدنى بالتركيز الاعلى اثرا ايجابيا على زيادة المحصول المبكر والكلى

٥- ادى اضافة السماد الحيوى الى زيادة المحصول المبكر والكلى عنه فى نباتات المقارنة وكان المحصول اعلى مايمكن مع معاملة ٣ كجم/فدان بيوجين .

٦- افضل المعاملات سجلت مع التركيز العالى من السماد المعدنى مع ٣ كجم/فدان بيوجين.

٧- أدى التفاعل بين السماد المعدنى والحيوى (٣ كجم/فدان بيوجين) الى انتاج افضل صفات الثمرة (متوسط وزن الثمرة ومحتوى الثمار من السكريات الكلية والمواد الصلبة الذائبة) .